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Perinatal mortality in Ireland: inequalities by socio-economic group and country of birth

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Background: While perinatal mortality rates have decreased in Ireland in recent years, it is not known if this reduction was shared equally among all groups. The aim of this study is to examine inequalities in perinatal mortality by country of birth and socio-economic group in Ireland between 2004 and 2019. **Methods:** Data for the analysis was obtained from the National Perinatal Reporting System dataset, which includes all births (including stillbirths) in Ireland. The rate and risk ratios for perinatal death were calculated for mothers' socio-economic group and country of birth for two time periods (2004–11 and 2012–19). Adjustment was made for mothers' age, marital status, parity and country of birth/socio-economic group. A total of 995 154 births and 5710 perinatal deaths were included in the analysis. **Results:** With the exception of African born mothers, the perinatal mortality rate decreased for all groups over time; however, inequalities persisted. Relative to Irish born mothers, the risk for African born mothers increased from 1.63 to 2.00 over time. Adjusting for other variables including socio-economic status reduced but did not eliminate this elevated relative risk. Mothers who were classified as unemployed or engaged in home duties had a higher risk of a perinatal death relative to higher professional mothers, with the relative risk remaining relatively constant over time. **Conclusions:** Reducing inequalities in health is a key objective of the Irish government. Further research is required to identify why perinatal mortality continues to be higher in some groups so that targeted action can be implemented.

Introduction

Over time there have been significant reductions in adverse pregnancy outcomes in many high-income countries.[1] However, those from deprived socio-economic backgrounds and minority ethnic groups tend to experience higher rates of a range of adverse outcomes, including stillbirths and early neonatal deaths.[2–5] The evidence on changes in the extent of inequalities over time is mixed. Smith et al.,[6] for example, examining neonatal mortality in England found that the relative neonatal mortality gap between the most deprived tenth of the population of births and the least deprived tenth increased from 2.08 in 1997–99 to 2.68 in 2003–05 before falling to 2.35 in 2006–07. In Scotland, Harpur et al.[7] found that while socio-economic inequalities in stillbirth and infant mortality were relatively consistent though time, there was some evidence to suggest that mortality rates in the most deprived groups deteriorated over time.

In Ireland, a small number of studies have examined inequalities in adverse pregnancy outcomes.[8–13] Similar to other countries, these analyses identified socio-economic and ethnic inequalities for a range of outcomes. Layte and Clyne,[9] for example, found that controlling for maternal age and parity, women whose partners were classified as unskilled/unemployed had a perinatal mortality rate 79% higher than women with partners classified as professional; the analysis also found that African mothers were much more likely to experience a perinatal death than any other group.

In recent years, Ireland has experienced significant economic, social and demographic change. The Irish economy has transformed from being one of the European Union's (EU) poorer performing countries in the early-to-mid 1990s to one experiencing strong economic growth thereafter up to 2008;[14] while economic conditions deteriorated rapidly during the Great Recession of 2008, there has been a sustained recovery in recent years. Migration patterns have also changed—inward migration to Ireland increased rapidly from about 2004;[15] the recession of 2008 resulted in a sharp decline in inward migration, but from 2015 net immigration resumed alongside the strong economic recovery.[15] Consistent with the strong economic growth, average disposable incomes have increased over time, and while income inequality, income poverty and deprivation have decreased, some groups continue to experience high rates of income poverty and deprivation, including lone parents.[16] Population health too has improved with Ireland moving from having the highest mortality rates in the EU-15 in the latter half of the 20th century to convergence with the EU-15 in recent years.[17]

Given these changes, Ireland provides a useful case study to consider how such changes might impact on health inequalities over time. Perinatal mortality can act as an indicator of the quality of antenatal and perinatal care.[18] However, in addition to the quality of healthcare, the perinatal mortality rate is influenced by a range of other individual and societal factors[19] and is an important indicator of socio-economic development. While perinatal mortality rates have declined in recent years in Ireland, identifying those most at risk of a perinatal death can help identify targeted interventions with which to further reduce the number of perinatal deaths.

The aim of this article is to examine inequalities in perinatal mortality by socio-economic group and country of birth in Ireland between 2004 and 2019.

Methods

In Ireland, births are notified and registered on a four-part Birth Notification Form, which is used to notify local registrars of all live births and stillbirths occurring in Ireland. The third part of this form has all identifying information removed and is sent to the Healthcare Pricing Office for registration on the National

Perinatal Reporting System (NPRS) dataset.[10] Data for this analysis was derived from the NPRS. The NPRS includes information on ~70 000 birth records in Ireland each year from 19 maternity units and all practicing self-employed community midwives.[10] In accordance with World Health Organization guidelines, only births weighing 500 g or more are included in the dataset.[10] The NPRS dataset includes a range of demographic, clinical and administrative data.[10]

In keeping with similar work,[3,6,8] the analysis was restricted to singleton births as differential access to fertility treatment could lead to a greater incidence of multiple births in more socio-economically advantaged individuals and perinatal mortality is generally higher in multiple births relative to singleton births.[6] To examine changes in inequalities over time, the analysis included data from 2004 to 2019, grouped into two time periods—2004–11 and 2012–19. Each time period provides a sufficient number of perinatal deaths to enable disaggregation of the perinatal mortality rate by parental characteristics. In addition, as detailed in the Introduction, the two time periods capture varying economic and social circumstances in Ireland including a period of significant economic growth and early recession (2004–11) and a period of recovery (2012–19). The outcome measure was perinatal mortality, which includes stillbirths and the death of a live born infant during the first week of life. The focus of this analysis was on inequalities in perinatal mortality by mothers' country of birth and socio-economic group (table 1).

A total of 12 country of birth categories are included in the NPRS dataset: Ireland, UK, EU15 (other than Ireland and UK), EU15-EU28, Rest of Europe, Africa, Asia, America, Australia, New Zealand and other Oceania, multi-nationality/other nationality/no nationality and not stated. For this analysis, country of birth was grouped into six categories: Ireland, UK, Europe, Africa, Asia and other (America, Australia, New Zealand and other Oceania and multi-nationality) (table 1). There have been some changes in the categories of country of birth used over time largely reflecting the expansion of the EU over the period of analysis, particularly in relation to new accession states. Consequently, the Europe category combines EU15, EU28 and 'rest of Europe' together to ensure consistency in included countries through time.

In the NPRS dataset, mothers' socio-economic group is coded and grouped, with minor modifications, according to the system of socio-economic groups used by the Central Statistics Office (CSO) in the 1991 Census of Population.[10] The CSO category of 'Unknown' has been differentiated into five distinct groups by the NPRS—'Unemployed', 'Not Classifiable', 'Not Applicable', 'Home Duties' and 'Not Stated'. Due to small numbers in some groups, the 11 socio-economic groups were combined into eight categories for the purpose of this analysis (table 1) based on the expected nature of the work within particular occupations.[8]

While a range of factors influence the likelihood of a perinatal death,[3–5] this analysis was restricted by the relatively small number of such factors available in the NPRS dataset. These include mother's age-group, marital status and parity. Supplementary tables S1 and S2 show the distribution of these variables across mother's country of birth and socio-economic groups, respectively. It shows that in relation to country of birth, European and Asian mothers tend to be younger than other county of birth groups, while Asian and African mothers are more likely to be married. In terms of socio-economic group, unemployed mothers tend to be younger and unmarried relative to other socio-economic groups.

In total, 995 154 births (518 054 in 2004–11 and 477 100 in 2012–19) and 5710 perinatal deaths (3230 in 2004–11 and 2480 in 2012–19) were included in the analysis. Supplementary table S3 details the number of births excluded from the analysis due to multiple births and missing data. The perinatal mortality rate per 1000 births was calculated for each country of birth and socio-economic group for the two time periods. Subsequently, logistic regression methods were used to calculate risk ratios for each group. Finally, adjusted and unadjusted attributable fractions were estimated for both country of birth and socio-economic group in both time periods. Attributable fractions identify how many perinatal deaths would have occurred if every group had the same risk rate as that of the best performing group.[4,20]

Results

There has been a decrease in the number of births over time from 518 054 in 2004–11 to 477 100 in the period 2012–19. The proportion of births to Irish and UK born mothers has decreased slightly, while the proportion of births to European born mothers has increased (table 1). In terms of socio-economic group, the proportion of births allocated to mothers classified as higher and lower professional groups has increased, while the proportion of births allocated to mothers engaged in home duties has decreased. In general, there has been an increase in the age of those giving birth, with 2.3% of mothers in 2004–11 aged under 20 compared to 1.3% in 2012–19. Conversely, the proportion of mothers aged 40 and over increased from 4.5% to 6.5% (table 1).

The overall perinatal mortality rate fell from 6.6 per 1000 births for 2004–11 to 5.2 per 1000 births for 2012–19. In terms of country of birth, mothers born in Africa had the highest perinatal mortality rate in both time periods (table 2). While the rate for most groups decreased over time, this was not the case for African mothers, where the rate increased slightly between the two time periods. Higher perinatal mortality rates were observed in both time periods in mothers classified as unemployed or engaged in home duties. While the perinatal mortality rate decreased for all socio-economic groups over time, relatively large declines in some groups (e.g. non-manual and salaried employees and manual and farming groups) meant that the gap between these groups and the best performing socio-economic groups (e.g. higher and lower professionals) decreased. However, large differentials continued to exist between the higher and lower professional groups and the unemployed and home duties groups over time.

Table 3 shows unadjusted and adjusted (for age, parity, marital status and socio-economic group/country of birth) risk ratios for perinatal mortality across country of birth and socio-economic groups over time. In both the adjusted and unadjusted analyses, relative to Irish born mothers, mothers whose country of birth was classified as Europe were significantly less likely to experience a perinatal death, while mothers born in Africa were significantly more likely to experience a perinatal death. The unadjusted risk ratio for African mothers increased from 1.63 to 2.00 over time. Adjusting for other variables including socio-economic status reduced but did not eliminate the elevated relative risk for African born mothers.

In both the adjusted and unadjusted analysis, mothers who were classified as unemployed or engaged in home duties had a higher risk of a perinatal death relative to higher professional mothers, with the relative risk remaining relatively constant over time.

Table 4 shows the adjusted and non-adjusted attributable fractions for perinatal mortality by country of birth and socio-economic group. According to the fully adjusted model, if all mothers had the same perinatal mortality rate as European mothers, then ~19% of perinatal deaths could have been avoided in 2004–11 and 21% avoided between 2012 and 2019. Similarly, if all groups had the same perinatal mortality rate as higher professionals, 17% of perinatal deaths could have been avoided between 2004 and 2011 and 20% of perinatal deaths could have been avoided in 2012–19.

Discussion

Similar to other high-income countries, the perinatal mortality rate in Ireland has decreased through time. However, inequalities between groups remain. A number of interrelated risk factors acting from preconception, through pregnancy and after birth are likely to contribute to the inequalities observed in this analysis. These include maternal factors, such as mothers' physical health prior to and during pregnancy, age, smoking, substance misuse and nutritional intake

Table 1 Variables and categories used in the analysis

		2004–11		2012–19	
Total		**Total births 518 054 %**	**Deaths 3230 %**	**Total births 477 100 %**	**Deaths 2480 %**
Outcome	Alive (excluding early neonatal death)	99.4		99.5	
	Perinatal death (still birth or early neonatal death)	0.6		0.5	
Country of birth of mother	Ireland	79.3	78.8	77.3	78.1
	UK	2.9	3.1	2.3	2.3
	Europe	10.0	8.4	13.5	10.7
	Africa	3.3	5.4	2.1	4.2
	Asia	3.4	3.7	3.6	3.8
	Other (America, Australia, New Zealand and other Oceania and multi-nationality)	1.1	0.7	1.3	1.0
Socio-economic group of mother	Higher professionals	6.2	5.1	7.5	6.0
	Lower professionals	14.8	12.1	19.6	16.3
	Employers and managers	7.5	6.8	7.6	6.5
	Intermediate non-manual workers	23.3	19.9	20.0	19.1
	Other non-manual workers and salaried employees	14.9	15.1	16.1	13.8
	Manual workers, farming and agricultural occupations	5.6	5.6	4.7	4.1
	Unemployed	4.0	5.8	4.8	6.0
	Home duties	23.7	29.7	19.6	28.4
Age-group of mother	<20	2.3	2.8	1.3	1.6
	20–24	11.6	14.1	8.3	9.6
	25–29	23.6	20.7	18.9	16.9
	30–34	35.3	31.7	36.3	32.0
	35–39	22.8	22.5	28.7	29.8
	40+	4.5	8.2	6.5	10.0
Marital status of mother	Married	67.6	62.7	63.0	59.2
	Single	30.7	35.2	35.6	38.6
	Other (including widowed, separated, divorced and civil partner)	1.7	2.1	1.5	2.3
Parity	Primiparous	40.1	42.4	37.7	37.0
	Multiparous	59.9	57.6	62.3	63.0

Table 2 Perinatal mortality rates by country of birth and socio-economic group, 2004–11 and 2012–19

	2004–11	2012–19
Overall	6.6	5.2
Country of birth		
Ireland	6.2	5.3
UK	6.8	5.2
Europe	5.3	4.1
Africa	10.1	10.4
Asia	6.6	5.4
Other	4.0	4.1
Socio-economic group		
Higher professional	5.1	4.2
Lower professional	5.1	4.3
Employers and managers	5.6	4.4
Intermediate non-manual	5.3	5.0
Other non-manual and salaried employees	6.3	4.4
Manual workers, farming and agricultural occupations	6.3	4.5
Unemployed	9.1	6.5
Home duties	7.8	7.5

during pregnancy;[21–24] many of which are in turn associated with socio-economic status.[6,19,25] However, wider societal issues including environmental exposures, poorer access to maternity care and increased stress because of economic strain and insecure employment can also contribute to adverse pregnancy outcomes among more disadvantaged groups.[26] A recent analysis by Jardine et al.[4] of adverse pregnancy outcomes in England concluded that much of the observed socio-economic inequalities could be explained by ethnicity, maternal smoking and body mass index (BMI) at the start of pregnancy. However, the authors of that analysis also noted that excess adverse outcomes among non-White mothers were not fully explained by socio-economic deprivation, maternal smoking or BMI, suggesting that the factors underlying socio-economic and ethnic inequalities may differ. In addition to deprivation, previous analysis has suggested that ethnic differences in outcomes could be related to language and cultural differences, which impede access to healthcare services, discrimination based on race or religion[3] or to physiological differences between groups.[27]

Previous research has shown that a range of factors have contributed to the decline in perinatal mortality across high-income countries including developments in antenatal and postnatal care[28–30] as well as changes in maternal risk factors, such as smoking, maternal age and obesity.[14,31] While most groups included in the current analysis experienced a decline in their perinatal mortality rate over time, this was not the case for mothers born in Africa and those engaged in home duties, despite having relatively high perinatal mortality rates at the outset of the period of analysis. Further work is required to identify why improvements have been slower to translate to some groups. This should include an assessment of changes in the composition of the groups over time. For example, the age composition of African mothers has increased between the two time periods with 34% aged 35 and older in the later period, relative to 22% in the earlier period. Indeed, adjusting for age reduces the relative risk for African born mothers in both time periods (but does not attenuate it fully). Alternatively, it could be that the higher rate among African mothers who give birth in Ireland reflects the relatively high perinatal mortality rates in Africa.[32] It is not known when those mothers

Table 3 Adjusted and unadjusted risk ratios (and associated confidence intervals) for perinatal mortality by county of birth and socio-economic group, 2004–11 and 2012–19

	Unadjusted	Adjusted[a]
Country of birth		
2004–11		
Ireland	1.00	1.00
UK	1.10 (0.91–1.35)	1.03 (0.84–1.25)
Europe	0.85 (0.75–0.96)	0.81 (0.71–0.92)
Africa	1.63 (1.40–1.91)	1.49 (1.27–1.74)
Asia	1.07 (0.89–1.29)	1.08 (0.89–1.30)
Other	0.65 (0.42–0.98)	0.61 (0.40–0.93)
2012–19		
Ireland	1.00	1.00
UK	0.98 (0.75–1.29)	0.91 (0.70–1.20)
Europe	0.78 (0.69–0.89)	0.77 (0.67–0.88)
Africa	2.00 (1.64–2.43)	1.64 (1.34–2.00)
Asia	1.04 (0.84–1.28)	0.97 (0.78–1.20)
Other	0.78 (0.52–1.15)	0.72 (0.49–1.07)
Socio-economic group	**Unadjusted**	**Adjusted[b]**
2004–11		
Higher professionals	1.00	1.00
Lower professionals	1.01 (0.84–1.21)	1.02 (0.85–1.23)
Employers and managers	1.11 (0.90–1.36)	1.11 (0.90–1.36)
Intermediate non-manual	1.06 (0.89–1.25)	1.08 (0.91–1.28)
Other non-manual and salaried employees	1.25 (1.05–1.50)	1.28 (1.07–1.53)
Manual workers, farming and agricultural occupations	1.24 (1.00–1.53)	1.30 (1.05–1.61)
Unemployed	1.80 (1.46–2.23)	1.76 (1.41–2.19)
Home duties	1.55 (1.31–1.83)	1.62 (1.37–1.93)
2012–19		
Higher professional	1.00	1.00
Lower professionals	1.04 (0.86–1.25)	1.05 (0.87–1.27)
Employers and managers	1.07 (0.85–1.33)	1.07 (0.85–1.34)
Intermediate non-manual	1.20 (0.99–1.44)	1.24 (1.03–1.50)
Other non-manual and salaried employees	1.07 (0.88–1.30)	1.14 (0.93–1.39)
Manual workers, farming and agricultural occupations	1.08 (0.84–1.39)	1.20 (0.93–1.56)
Unemployed	1.56 (1.24–1.96)	1.65 (1.30–2.10)
Home duties	1.81 (1.52–2.17)	1.92 (1.59–2.31)

a: Adjusted for age, parity, marital status and socio-economic group.
b: Adjusted for age, parity, marital status and country of birth.

Table 4 Adjusted and unadjusted attributable fractions (and associated confidence intervals) for perinatal mortality by county of birth and socio-economic group, 2004–11 and 2012–19

	2004–11	2012–19
Country of birth (ref—Europe)		
Unadjusted	15.8 (5.7–24.8)	21.1 (11.6–29.6)
Adjusted	19.2 (9.2–28.0)	21.4 (11.7–30.0)
Socio-economic group (ref—higher professionals)		
Unadjusted	19.0 (5.9–30.2)	20.1 (6.59–31.6)
Adjusted	17.4 (3.9–28.9)	20.0 (6.1–31.5)

born in Africa (or elsewhere) moved to Ireland. Consequently, the higher risk among African mothers might reflect their exposures and experiences in Africa before they come to Ireland before or even during pregnancy.

The main strength of this study is the inclusion of nearly all registered births (over 500 g weight) recorded in Ireland from 2004 to 2019. It was however necessary to exclude those for which there was missing data on country of birth or socio-economic group. The analysis was also somewhat constrained by the limited number of variables included in the NPRS dataset. For example, there is no information on maternal smoking or BMI which other studies have found to explain some of the socio-economic inequalities observed in adverse pregnancy outcomes.[4] In addition, there is no information on mothers' ethnicity, and it was necessary to use country of birth as a proxy. While there is an overlap between ethnicity and country of birth, the use of country of birth means that the experience of some minority groups who were born in Ireland were not captured in the analysis.

Finally, some caution is required in assessing the attributable fractions presented in Table 4 as their interpretation as the percentage of perinatal deaths that would not have occurred if all mothers had the same socio-economic grouping/country of birth as the best performing group is based on the assumption that there is no effect modification.[4] However, this may not be the case here as exposures such as socio-economic status and country of birth are linked to many other factors, including overall health, health-related behaviour, lifestyle factors and other aspects of adversity that can also contribute to perinatal mortality.[4]

While perinatal mortality rates have fallen in Ireland in recent years, it is likely that further improvements could be made given that a recent analysis found Ireland to be mid-table among 16 selected EU countries in terms of their perinatal mortality rates in 2019.[10] Recent reform proposals in Ireland have highlighted the need to address health inequalities.[33] Identifying why some groups continue to experience higher perinatal mortality rates and targeting such groups would help tackle current inequalities and likely reduce the overall perinatal mortality rate.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Conflicts of interest: None declared.

Data availability

The data underlying this article cannot be shared publicly as the data were provided under a data sharing agreement [with the Healthcare Pricing Office (part of the Health Service Executive)], which stipulated that the data can only be accessed by those named in the agreement.

Key points

- While the perinatal mortality rate has declined in Ireland in recent years, inequalities in perinatal mortality have persisted.
- African born mothers are significantly more likely than Irish born mothers to experience a perinatal death, with the relative risk increasing over time.
- Mothers who were unemployed or engaged in home duties had a higher risk of a perinatal death than professional mothers, with the relative risk remaining relatively constant over time.

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